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Langley Research Center

Bubble-Domain Circuit Wafer Evaluation Coil Set

The evaluation of bubble-domain device wafers prior to dice operation is necessary to minimize garnet (bubble-domain substrate) waste and to select and identify good chips. Coil structures have been designed to fulfill all the requirements of bubble wafer inspection. With them, the wafers can be either electrically or optically accessed and operated from quasi-static frequency to maximum device operating frequency.

Figure 1 shows a new in-plane field coil winding. Two orthogonal flat coils are wound around a ferromagnetic plate for supplying a rotating field parallel to the ferrite plate in the space above the coil winding. The ferrite plate isolates the top (A) and bottom (B) windings so that when a garnet device (C) is placed on top of the coil, it will "see" a magnetic field generated from a layer of parallel conductor currents. The in-plane field, above the center of the winding, is uniformly parallel to the ferrite plane and has no vertical component. The size of this uniform field area depends on the size of the coil winding and the distance to the coil winding.

To achieve a minimum vertical component of the in-plane field, two ferrite coils are arranged as top and bottom coils with a space between. The current directions in the coils are arranged so that the in-plane field components aid each other and the vertical components cancel each other in the space between the coils.

The required bias field can be supplied by a regular flat circular coil. Figure 2 shows the arrangement where the in-plane coil windings enclose both the bias field coil (Z-axis winding) and the ferromagnetic shielding plate. The wafer sample to be inspected can be placed directly on top of this coil structure. The sample is readily available to the electrical probe. The magnetic domain motion can also be observed by using a reflected polarized-light microscope.

For a high-frequency arrangement, the bias coil is mounted outside the in-plane coil so that the in-plane coil size will not be limited by the bias coil. A small winding on a piece of high-frequency ferrite plate enables the coil to be driven to very high frequency.

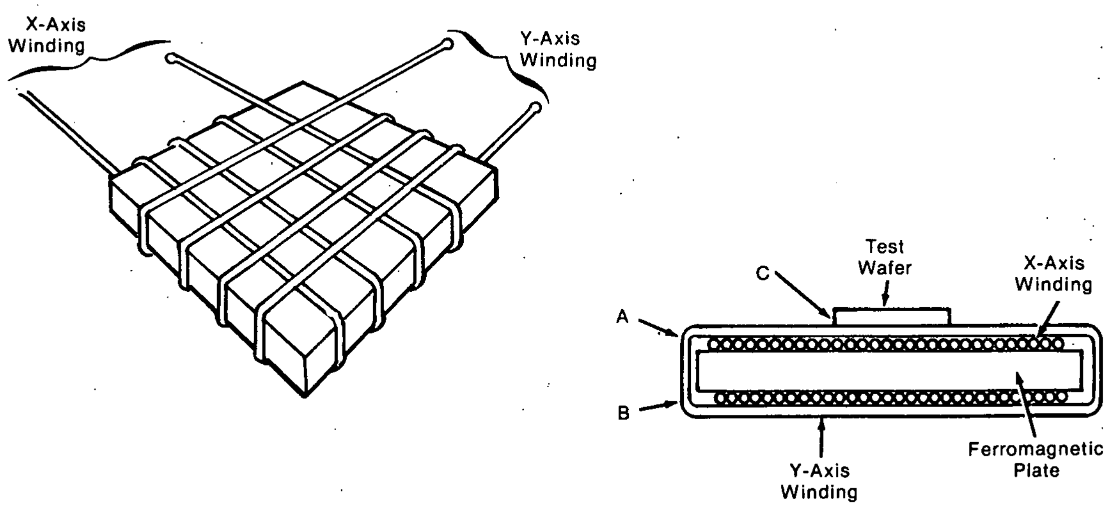

Figure 1. In-Plane Field Coil Winding

(continued overleaf)

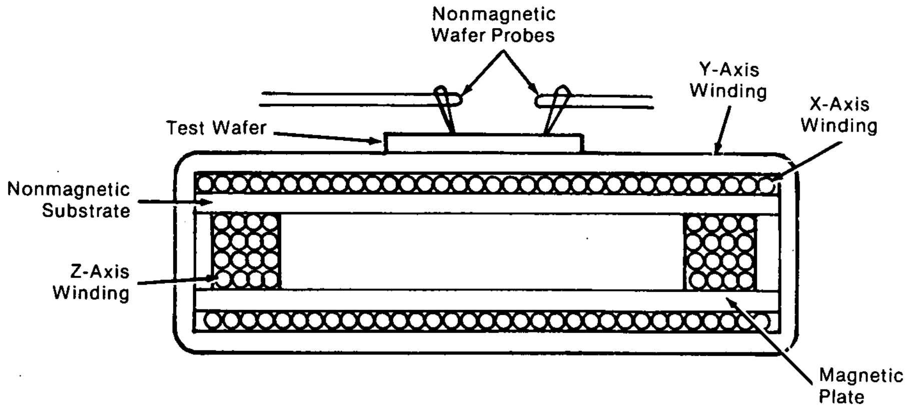

Figure 2. In-Plane Coil Windings Enclosing Both Bias Field Coil and Shielding Plate

The garnet wafer can be inserted freely and without limitation between the in-plane and bias coils. The electrical testing probes can be either inserted through the center hole of the bias coil or attached under the coil and connected from the side. For visual observation, microscope objectives can be inserted through the center hole of the bias coil.

Another design provides more accurate measurement of device characteristics, such as operating margin. The rotating field is supplied by two ferrite coils, and the bias field is generated from a flat coil pair. A wafer and wafer probes are inserted between the coil pair. It is still an open structure as the top coils are removed for probe alinement and visual inspection. Since there is minimum vertical bias modulation due to in-plane rotating fields, the ferrite coil size can be substantially reduced so that it can be easily driven to very high frequency.

Note:

Requests for further information may be directed to:

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Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457(f)], to the Rockwell International Corporation, Anaheim, California 92803.

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